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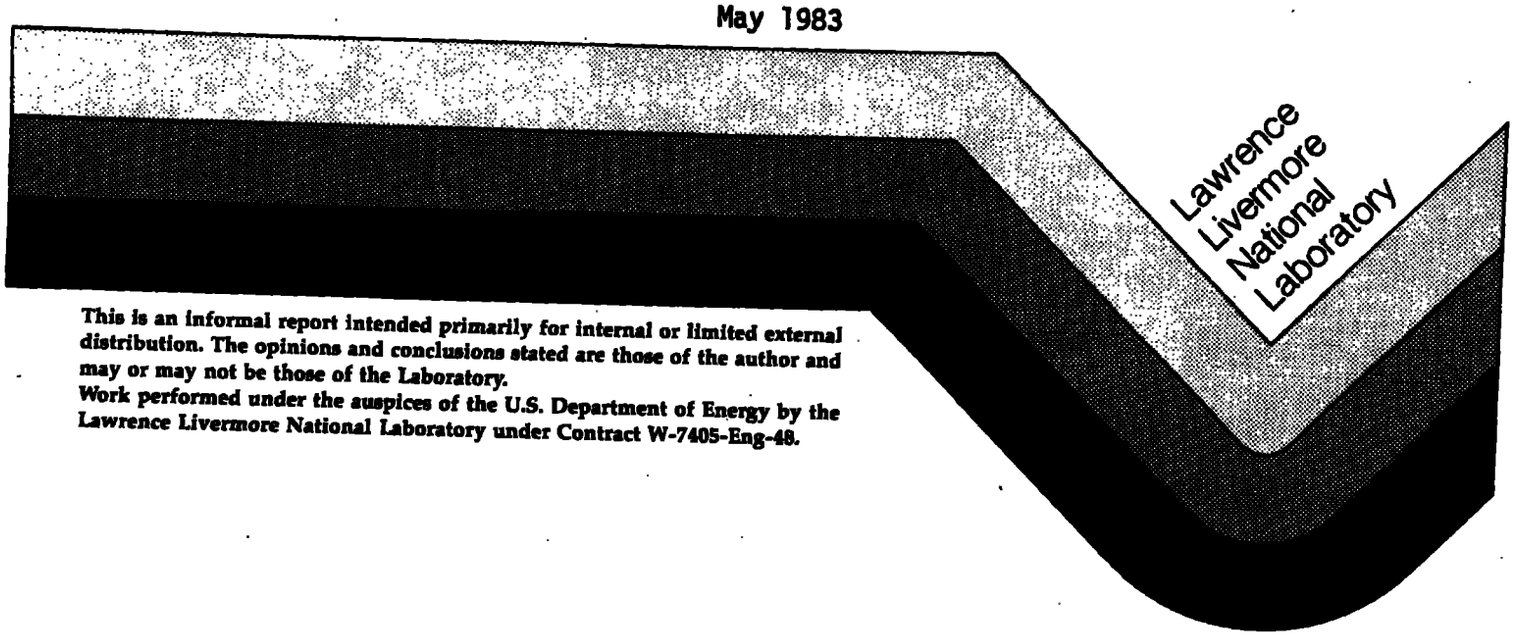

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Introduction

Each year the Engineering Research Division of the Electronics Engineering Department has issued an internal report listing all formal publications produced by the division during the calendar year.

83-1 THE SYNTHESIS OF SURFACE REACTANCE USING AN ARTIFICIAL DIELECTRIC
UCRL-88338, 1983
IEEE Transactions on Antennas and Propagation Vol. Ap-31(3), May, 1983, pp. 471-476

R. J. King
D. V. Thiel
K. S. Park

Artificial Dielectric
Guided Waves
Surface Reactance, Synthesis of

Abstract

A thin artificial dielectric layer consisting of a rectangular array of closely spaced, thin conductive cylinders (pins), was constructed above a perfectly conducting ground plane. The reactance of the surface was measured at 4.8 GHz for a variety of pin heights and dielectric embedding material by measuring the height-gain profile of a TM surface wave launched across it. Design equations using the theories of artificial dielectrics and propagation in anisotropic media are given. These can be used to predict the surface reactance providing a correction factor accounting for fringing fields at the tops of the pins is included. Using an embedding dielectric tends to reduce this fringing effect.

83-2 USING A MICROPROCESSOR TO CALIBRATE AND CORRECT CCDS
UCRL-53355, 1983

C. F. McConaghy
G. C. Tyler

Microprocessing

Abstract

In order to improve the data quality in charge coupled devices, multiple calibration techniques need to be utilized. A few words must be said about the operational environment from which the solution to our hardware measurement problem arose. The internal configuration of the Serial Parallel Serial Charge Coupled Device (SPSCCD) requires both amplitude and time correction to restore its output of the raw data back in to the form of the original input signal. The original data, which is desired to be recovered, had been transformed in sophisticated hardware using a number of conversion processes. These involved many serial to parallel and back to serial processes.

83-3 A FRAMING CAMERA TUBE FOR SUBNANOSECOND IMAGING APPLICATIONS
UCRL-88691, Rev. 1, 1983

R. Kalibjian
S. Thomas

Framing Camera Tube

Abstract

A dissector/restorer type framing camera tube (using a 3.9 kV/ns deflection driver) has been characterized with a Nd:YAG mode-locked laser. The 3-frame format tube referenced to the photocathode has a 5 x 5 mm field-of-view and 0.3 ns duration frames with better than 5 lp/mm spatial resolution.

83-4 THE ASYMPTOTIC POINCARE LEMMA AND ITS APPLICATIONS
UCRL-87947, Rev. 2, July 1983
Submitted to SIAM Journal on Mathematical Analysis

R. W. Ziolkowski
G. A. Deschamps

Asymptotics
Oscillatory Integrals
Poincare Lemma

Abstract

An asymptotic version of Poincare's Lemma is defined and solutions are obtained with the calculus of exterior differential forms. They are used to construct the asymptotic approximations of multidimensional oscillatory integrals whose forms are commonly encountered, for example, in electromagnetic problems. In particular, the boundary and stationary point evaluations of those integrals are considered. The former is applied to the Kirchhoff representation of a scalar field diffracted through an aperture and simply recovers the Maggi-Rubinowicz-Miyamoto-Wolf results. Asymptotic approximations in the presence of other (standard) critical points are also discussed. Techniques developed for the asymptotic Poincare Lemma are used to generate a general representation of the Leray form. All of the (differential form) expressions presented are generalizations of known (vector calculus) results.

83-5 PERFORMANCE OF AN ARRAY OF VERTICAL DIPOLES OVER AN INHOMOGENEOUS GROUND SYSTEM

R. J. King
N. C. Mathur

UCRL-88555, January 1983
Presented at International IEEE/AP-S Symposium and National Radio Science Meeting, Houston, Texas, May 23-26, 1983
To be published in Electromagnetics 1983 (In Press)

Array
Antenna Ground Systems
Antenna Patterns (HF)

Abstract

In HF communications and radar, narrow beams are frequently produced by arrays. Narrow steerable beams are particularly important in HF over-the-horizon radar. The design of such arrays located over inhomogeneous ground systems is difficult and the literature on this subject is scant. It is complicated by the fact that the radiation field of a dipole located over such a ground is complex, difficult to evaluate, and also height-dependent. Thus, in effect, the problem is one of understanding the performance of an array of antennas of dissimilar radiation patterns.

83-6 TRANSIENT PROTECTION OF ELECTRICALLY SMALL APERTURES

K. F. Casey

UCRL-88617/Abstract, January 1983
Submitted to IEEE International Symposium on Electromagnetic Compatibility
Washington, DC, August 1983

Aperture Penetration
Electromagnetic Shielding
Transient Protection

Abstract

It is well known that apertures in an otherwise closed conducting surface can represent substantial points of entry of electromagnetic energy into the interior region. Certain apertures, however, are necessary for visibility, airflow, or communication between the exterior and interior and must therefore be protected against unwanted electromagnetic penetration while retaining their intended function. Means for protecting such apertures by conductive-film or wire-mesh loading have been studied both analytically and experimentally in the frequency domain. Our purpose in the present paper is to examine certain time-domain transient aspects of the problem.

Specifically, we consider the electromagnetic field radiated by a loaded circular aperture in an extended conducting plane under transient excitation. The aperture is considered to be electrically small over the frequency range of interest, and we make use of an accurate analytical solution for the loaded aperture polarizability to construct the electromagnetic field radiated into the shielded region. In the absence of any aperture loading, the aperture dipole moment induced by the incident field follows the time history of that field. When the aperture is loaded, a low-pass filter is effectively introduced into the process, changing the time history of the aperture dipole moment and thus of the radiated field.

It is of interest in system shielding applications to estimate the penetrant energy under conditions of transient (pulse) excitation. This we do for the loaded aperture, and we demonstrate how one may derive an equivalent aperture area to describe the pulse penetration into the interior (shielded) region.

83-7 AVALANCHE DEVICES STATE OF THE ART — M. D. Pocha
UCRL-88536/Abstract, January 1983
Presented at the ARO Sponsored Workshop
on Solid State Switches for Pulsed Power
Tamarron, Colorado, January 12-14, 1983

Fast Switching Devices

Abstract

Avalanche Transistors have been used for several years to generate fast risetime, high voltage electrical pulses. This paper describes the state of the art in the capabilities of devices available commercially and work done in our Solid State Devices group. We have been able to significantly improve the characteristics of devices fabricated in house over those of commercial devices.

83-8 PERSONAL COMPUTER APPLICATIONS IN ELECTROMAGNETICS — E. K. Miller, G. J. Burke
UCRL-88544, January 10, 1983
Presented at 1983 International IEEE/APS
Symposium and Radio Science Meeting,
Houston, Texas, May 23-26, 1983

Personal Computer Applications

Abstract

It is barely ten years since introduction of the HP 35 scientific hand calculator, and six years since the first non-hobbyist, personal computers made their appearance (e.g., the Apple II, Commodore PET, Radio Shack TRS 80).

Now, second and third generation PCs are becoming available including the IBM PC, and the Apple LISA. These personal computers are advancing well beyond the role of arcade-game players, providing the computing power necessary for solving significant scientific and engineering problems. The purpose of this paper is to review briefly the capabilities of present PCs, and to illustrate their use for solving three kinds of electromagnetic problems.

First, a version of Mini-NEC, developed at Naval Ocean Systems Center by A. J. Julian, J. C. Logan and J. W. Rockway ("Mini-NEC: A Mini-Numerical Electromagnetic Code," NOSC Technical Document 516, 6 September 1982) will be outlined. This code, written in BASIC for an Apple II + computer, can handle in-core antenna and scattering problems involving wire objects having up to 55 segments. Second, a microcomputer version of TWTD, implemented by J. A. Landt of Los Alamos National Laboratory on a Commodore VIC 20 and adapted to an Apple II + by the author, will be discussed. This is a time-domain code for modeling impulsively excited wire objects as antennas or scatterers (E. K. Miller, "Time-Domain Modeling of Wires in Applications of the Method of Moments to Electromagnetic Fields," B. J. Strait Editor, SCEEE Press, 1980). Finally, the use of a PC for Prony-type signal processing including SEM pole calculation and eigen-value analysis, will be considered. These three representative applications will demonstrate that presently available PCs already have useful capabilities, with the promise that next-generation PCs will permit even more demanding problems to be handled.

83-9 GEOPHYSICAL TOMOGRAPHY

W. D. Daily
R. J. Lytle

UCRL-88539, January 10, 1983
Submitted to the Journal of
Geomagnetism and Geoelectricity

Remote Sensing Technique

Abstract

A remote sensing technique has been developed for high resolution mapping subsurface structures using radio-wave transmissions through the ground. A transmitter and receiver are lowered in boreholes drilled on opposite sides of the underground region to be imaged. The measured attenuation and velocity of the electromagnetic waves propagated between these boreholes is determined by the electromagnetic properties of the intervening media. Maps showing the distribution of these electromagnetic properties between the boreholes can be produced by tomographic reconstruction--a technique used for several years in medical x-ray imaging. In some cases these maps can be directly related to geologic structure. This remote sensing technique has a variety of possible applications including mapping underground fracture systems; locating tunnels or water-bearing strata; mapping burn fronts during in situ coal gasification and monitoring in situ oil shale retorts.

There are several economic constraints and factors which dictate a particular method of operation in designing with gate arrays for commerical applications. Most gate array vendors follow these methods of operations. The constraints are different when trying to apply gate arrays to R&D problems. For example, commerical applications generally stress reduction in production costs, whereas turnaround time and the design and development costs are generally more important to research projects.

83-10 INSTRUMENT RELIABILITY FOR HIGH-LEVEL NUCLEAR WASTE REPOSITORY APPLICATIONS
UCRL-86225, January 31, 1983
Submitted to Waste Management '83, Tucson, Arizona, February 27-March 3, 1983

F. Rogue
E. P. Binnall
G. A. Armantrout

Instrument Reliability

Abstract

Reliable instrumentation will be needed to evaluate the characteristics of proposed high-level nuclear waste repository sites and to monitor the performance of selected sites during the operational period and into repository closure. A study has been done to assess the reliability of instruments used in Department of Energy (DOE) waste repository related experiments and in other similar geological applications. The study included experiences with geotechnical, hydrological, geochemical, environmental, and radiological instrumentation and associated data acquisition equipment. Though this paper includes some findings on the reliability of instruments in each of these categories, the emphasis is on experiences with geotechnical instrumentation in hostile repository-type environments. We review the failure modes, rates, and mechanisms, along with manufacturers modifications and design changes to enhance and improve instrument performance; and include recommendations on areas where further improvements are needed.

83-11 POWER DEPOSITION PROFILES IN MAXWELLIAN MAGNETO-ACTIVE PLASMAS

R. W. Ziolkowski
J. C. Peterson

UCRL-88568, February 1983
Fifth Topical Conference on Radio Frequency Plasma Heating, University of Wisconsin, Madison, February 21-23, 1983

Power Deposition
Power Deposition Profiles
Geometrical Optics

Abstract

The numerical modeling of the microwave power deposition in a plasma for waves that are launched from an arbitrary array of pyramidal horns will be described. The waves are modeled in three dimensions with geometrical optics assuming the plasma is cold, magneto-active and Maxwellian. The power absorption at the fundamental harmonic is calculated along those rays with warm plasma absorption formulas. A newly developed post-processor synthesizes power deposition profiles from these ray tracing results. Graphical output includes the power density as a function of the distance along the axis of the plasma and the physical or midplane radius, the z-integrated power density as a function of the midplane radius, and the cumulative power absorbed as a function of the midplane radius. Examples for ECRH in the TMX-U and the axisymmetric MFTF tandem mirror machines at LLNL will be presented.

83-12 A REVIEW OF THE PHYSICS AND RESPONSE MODELS FOR BURNOUT OF SEMICONDUCTOR DEVICES

J. H. Yee
W. J. Orvis
L. C. Martin

UCID-19749, February 1983

P-N Junction Devices
Second Breakdown Phenomena

Abstract

Using a combination of the current literature and our own research, we describe the various physical mechanisms of failure of semiconductor devices due to electrical overstress and electromagnetic pulses. In particular, we describe the causes and effects of second breakdown phenomena in p-n junction devices. We also describe the currently used response models that simulate a semiconductor's response to high voltage transients in a circuit or system.

83-13 THE SCATTERING OF AN H-POLARIZED PLANE WAVE FROM AN AXIALLY SLOTTED INFINITE CYLINDER: A DUAL SERIES APPROACH

W. A. Johnson
R. W. Ziolkowski

UCRL-88829, February 1983
Submitted to Journal of Radio Science

Aperture Coupling
Electromagnetic Scattering
Slitted Cylinder

Abstract

The electromagnetic coupling problem as it applies to an enclosed region, an external source and a coupling aperture is one of major importance, both theoretically and from a practical point of view. Solutions of an analytic nature would provide insight into the coupling mechanism by which electromagnetic energy penetrates apertures into enclosed regions. Moreover, accurate solutions of problems of this type would provide standards for the evaluation of scattering codes, especially near the edge at the aperture rim where purely numerical techniques may encounter difficulties.

83-14 HIGH VOLTAGE, HIGH SPEED SWITCHING TRANSIENTS USING CURRENT MODE SECOND BREAKDOWN

M. D. Pocha
J. C. Koo

UCRL-88309, February 4, 1983
Elect. Components Conference,
Orlando, Florida, May 16, 1983

Current Mode Second Breakdown

Abstract

Current mode second breakdown is a fast negative resistance phenomena which occurs in bipolar epitaxial transistors and which can be used to generate fast rise time electrical pulses. This paper describes a study of this effect and the design of devices capable of generating pulses of greater than 500 volts with 3-4 ns rise time.

83-15 HIGH POWER MICROWAVE PULSE SUSCEPTIBILITY OF DISCRETE SEMICONDUCTOR DEVICES

C. F. McConaghy
L. C. Martin
J. H. Yee

UCRL-88702, February 10, 1983
Presented at High Power Microwave Conference
Adelphi, Maryland, Harry Diamond Laboratory
March 1, 1983

Second Breakdown Phenomena

Abstract

This paper describes work in process in the investigation of the susceptibility of semiconductor devices to short pulses of microwave energy. This investigation includes a combination of testing, circuit modeling, and basic physics modeling. The testing includes both unipolar (video) and microwave (GHz range) pulses in the nanosecond time regime. Modeling is oriented toward the explanation of second-breakdown phenomena and the development of a breakdown level prediction model. Preliminary results have been obtained for the 2N918 transistor.

83-16 TIME-TYING OF EMP TEST DATA

V. G. McGevna

UCID-19728, February 16, 1983

EMP Time Tying

Abstract

An algorithm for automatic time-tying of EMP data sets has been developed. The algorithm reflects the nature of the EMP data as well as the idiosyncracies of the data acquisition system. A number of performance measures which can be generated during time-tying have been identified. These can provide the capability of on-line monitoring of the data acquisition system. Computer monitoring can reduce the need for manual review of data and improve the quality of the data obtained during the course of a test.

83-17 CAVITY DETECTION AT THE NEVADA TEST SITE USING SURFACE EM TECHNIQUES: EXPERIMENTAL AND NUMERICAL RESULTS

E. M. Didwall
C. G. Dease
M. J. Wilt

UCRL-88941, March 1983
Submitted to 2nd Containment Symposium
August 2-4, 1983, Kirtland AFB
Albuquerque, New Mexico

Cavity Detection
Surface EM Techniques

Abstract

Experiments were conducted at the Nevada Test Site to see if subterranean cavities due to underground nuclear testing could be detected using surface electromagnetic (EM) techniques. Both telluric and controlled source methods were used. The telluric method utilizes naturally occurring earth currents which are induced by ionospheric and tropospheric electromagnetic activity--no electric field source is provided by the user. The controlled source method, which in this case used a horizontal loop powered by a generator, does require a user supplied source. Telluric measurements indicate that an anomaly exists where the cavity is expected. The controlled source experiment also showed anomalous values in magnet field magnitude, ellipticity, and tilt angle. When compared to numerical models, these signatures are stronger than expected. Possibly, this difference between numerical and experimental results may indicate that the geological phenomenon is of greater extent than the actual cavity. In any case, the results from these experiments indicate that EM survey methods are suitable for cavity detection.

83-18 THEORETICAL MODELING OF EMP INDUCED BREAKDOWN EFFECTS IN SEMICONDUCTOR DEVICES

W. J. Orvis
J. H. Yee
G. H. Khanaka
D. L. Lair

UCID-19900, June 1983
Account of work performed for the Air Force Weapons Laboratory, Kirtland AFB, New Mexico

Semiconductor
Second Breakdown

Abstract

In this report, we discuss the results from three numerical models that describe semiconductor device operation during an electromagnetic pulse (EMP) initiated electrical overstress (EOS). The models consist of a simple diode model, a simple transistor model and the general, one-dimensional, p-n junction device model. Semiconductor device operation is described by a set of coupled, stiff, nonlinear, partial differential equations.

These equations consist of the electron and hole continuity equations, Poisson's equation and the heat flow equation. The three numerical models perform one-dimensional solutions of these equations for various device configurations. The general, one-dimensional, p-n junction device model will be described in detail, with the results showing the physical phenomena taking place inside of a semiconductor device during an EOS.

83-19 FAILURE AND SWITCHING MECHANISMS IN SEMICONDUCTOR P-N JUNCTION DEVICES
UCRL-88923, March 1983
Submitted to IEEE Power Electronics Specialists Conference, Albuquerque, New Mexico, June 6-9, 1983

J. H. Yee
G. H. Khanaka
D. L. Lair
W. J. Orvis
L. C. Martin

P-N Junction Devices
Semiconductor

Abstract

Avalanche and breakdown mechanisms in semiconductor p-n junction devices are reviewed. Comparison between the existing experimental data and theoretical calculations concerning the second breakdown mechanisms is presented. It is shown that if one solves the complete set of the transport equations for the electrons and the holes, together with the heat transfer equation for the temperature, one obtains three kinds of second breakdown: current mode (CSB), thermal mode (TSB), and current-thermal (CSB-TSB) mode second breakdown phenomena.

83-20 ALTERNATE METHODS FOR DETERMINING THE ELECTRICAL CONDUCTIVITY OF CORE SAMPLES-II
UCRL-87656-Revision 1, March 1983
Submitted to the Review of Scientific Measurements

R. J. Lytle

Electrode Configurations

Abstract

Electrode configurations are described that can be used in measuring the electrical conductivity of a core sample from a borehole in the ground. The use of these configurations is warranted for laboratory measurements simulating the pressure and fluid flow conditions encountered at depth within the earth. Three particular electrode configurations are illustrated with numerical results depicting their relative merits.

83-21 EVALUATING THE RESPONSE OF COMPLEX SYSTEMS TO ENVIRONMENTAL THREATS: THE ΣII METHOD

G. C. Corynen

UCRL-88947/Summary, March 1983
Submitted to the Sixth MIT/ONR
Workshop on Command and Control
Massachusetts Institute of Technology
Cambridge, Massachusetts, July 25-29, 1983

Complex Systems Response

Abstract

The operation of complex systems in hostile environments involves a great variety of uncertainties. Their performance is therefore difficult to describe or predict with the accuracy often required when the consequences of system failures are intolerable. Various methods have been developed over the past ten years to account for these uncertainties, and for their impact on system performance. In the general analysis of reliability, security, safety, the techniques of fault trees, graphs, and networks have been applied to obtain practical methods. In the more specific area of system vulnerability to EMP (Electromagnetic Pulse) and other hostile environments, additional methods have been developed in the weapons community.

83-22 URANIUM MINES AND MILLS CHAPTER 2

W. J. O'Connell

UCID-19266, March 1983
Prepared for publication in
"Codes, Standards and Criteria
Applicable to the Civil and Structural
Design of Nuclear Fuel Cycle Facilities,"
A Report by the Nuclear Fuel Cycle
Committee, Structural Division, American
Society of Civil Engineers

Uranium Mining

Abstract

This chapter will be included in a larger ASCE Committee Report. Uranium mining production is split between underground and open pit mines. Mills are sized to produce "yellowcake" concentrate from hundreds to thousands of tons of ore per day. Miner's health and safety, and environmental protection are key concerns in design. Standards are set by the U.S. Mine Safety and Health Administration, the EPA, NRC, DOT, the states, and national standards organizations. International guidance and standards are extensive and based on mining experience in many nations.

83-23 NLS: A SYSTEM IDENTIFICATION PACKAGE FOR TRANSIENT SIGNALS
UCID-19767, March 1983

D. M. Goodman

System Identification
Transient Identification

Abstract

NLS is a system identification package designed specifically for determining difference-equation models for systems whose inputs and outputs are transients. In its present form the code is available only for a VAX 11/780 using the VMS operating system, but transporting it to a different system should not be difficult. I wish to emphasize that this document is a preliminary edition describing a preliminary version of NLS. Although a couple more months in writing this manual might have been reasonable, several users have run NLS with great success without having much knowledge of what it does or how to "tweak" it for better performance. Because NLS, even in its present unfinished state, appears to be the best package available for the transient problem, and because of the immediate demand for a user's manual, I decided to write this preliminary manual. The reader should not take the advice herein as the last word, and he should expect many changes in the final version of the code. many of the options, particularly in Chapter 6, are experimental and may be removed from the final version. Also, there are some modifications and additions to NLS which have yet to be tried. In Appendix I, I discuss some possibly useful modifications.

83-24 N-SERIES PROBLEMS AND THE COUPLING OF ELECTROMAGNETIC WAVES TO APERTURES: A RIEMANN-HILBERT APPROACH
UCRL-88906, March 1983
Submitted to SIAM Journal on Mathematical Analysis

R. W. Ziolkowski

N-Series Problems
Dual Series Equations
Triple Series Equations

Abstract

An effective approach to the solution of a large class of mixed boundary valve problems (those reducible to an n-series problem) is developed. The method is based on the deduction of the equivalent Riemann-Hilbert problem and its solution. This generalized n-series approach leads to analytical descriptions of the coupling of electromagnetic waves through apertures in canonical structures into open or enclosed regions. In particular, it is applied to the canonical problem of plane wave coupling to an infinite circular cylinder with multiple infinite axial slots. Numerical results for currents indiced by an H-polarized plane wave on a circular cylinder with a single slit are given.

83-25 FUNDAMENTAL CONCEPTS OF DIGITAL IMAGE PROCESSING R. E. Twogood
UCRL-88952, March 1983
Invited Paper for the International Symposium and Course on Electronic Imaging in Medicine
San Antonio, Texas

Image Enhancement
Image Processing
Two-Dimensional Filtering

Abstract

The field of a digital image processing has experienced dramatic growth and increasingly widespread applicability in recent years. Fortunately, advances in computer technology have kept pace with the rapid growth in volume of image data in these and other applications. Digital image processing has become economical in many fields of research and in industrial and military applications. While each application has requirements unique from the others, all are concerned with faster, cheaper, more accurate, and more extensive computation. The trend is toward real-time and interactive operations, where the user of the system obtains preliminary results within a short enough time that the next decision can be made by the human processor without loss of concentration on the task at hand. An example of this is the obtaining of two-dimensional (2-D) computer-aided tomography (CAT) images. A medical decision might be made while the patient is still under observation rather than days later.

83-26 INTERACTIVE TOOLS FOR DATA EXPLORATION S. A. Bly
UCRL-88958, March 16-18, 1983
Submitted to Computer Science and Statistics: Fifteenth Symposium on the Interface

Data Output Techniques
Interactive Tools

Abstract

In complex data problems involving unknown structures and relationships, techniques which help analysts find features and characteristics of that data are particularly important. These techniques are useful predecessors to formal analysis methods. Computers have provided computation power to make a wide variety of such techniques available for data exploration.

A computing facility with locator input, color graphics output, and audio output offers the basis for interactive data presentation tools. One such tool uses visual and aural representations of data to give the

analyst a variety of perspectives of the data. By combining user interactivity with various data output techniques, the analyst can dynamically explore complex data sets looking for patterns, structures, relationships, and features. With application to example data sets, this tool illustrates a means of data exploration.

83-27 FOCUS WAVES MODES IN HOMOGENEOUS MAXWELL'S EQUATIONS: TRANSVERSE ELECTRIC MODE — J. N. Brittingham

UCRL-86512, March 1983
Lawrence Livermore National Laboratory, University of California, Livermore, California, Received 11 December 1981; Accepted for Publications October 22, 1982

Abstract

This paper presents mathematical formulations for new, three-dimensional, packet-like solutions to the free-space homogeneous Maxwell's equations. These solutions are real, nonsingular, continuous functions which propagate in a straight line at light velocity. They main focused for all time. The asymptotic behavior of the fields away from the moving pulse center has a magnitude which decreases as the inverse of the distance from the pulse centers.

83-28 NUMERICAL AND EXPERIMENTAL RESULTS FOR DETECTION OF UNDERGROUND VOIDS USING CONTROLLED SOURCE ELECTROMAGNETIC TECHNIQUE — E. M. Didwall, C. G. Dease

UCRL-88968/Rev. 1, Abstract, April 1983
Submitted to Society of Exploration Geophysics (SEG), Las Vegas, Nevada, September 1983

Underground Void Detection

Abstract

This work is part of a study to evaluate various electromagnetic (EM) geophysics techniques for the detection of subsurface voids or rubble-filled cavities. Typical dimensions of the cavities are expected to be of the order of 10's of meters in diameter and at depths of 30 meters or more. To evaluate the surface EM techniques, a computer code was developed. This code calculates the scattered EM fields from a subterranean three-dimensional structure; in this case, an air-filled void for frequencies of 10 Hz to 10 kHz.

83-29 IDENTIFICATION OF ANTENNA PARAMETERS FROM TIME-DOMAIN PULSE RESPONSE DATA
UCID-19770, April 1983

G. A. Clark
L. C. Martin
E. J. Bogdan

Antenna Parameters
Identification
Time Domain

Abstract

This report analyzes the important and difficult problem of identifying antenna parameters from transient electromagnetic data. The identification problem is defined and shown to be difficult for the transient case. Several identification schemes are discussed and examples of results are given.

The most promising technique for transient identification appears to be one using a linear pole-zero model that is estimated iteratively using the entire data record pair at each iteration. We call this an "iterative batch" technique, and an example identification is presented for a 30-cm monopole antenna because its properties are known theoretically. It is shown that the calculated impedance and effective height values agree with theory.

Emphasis is placed on the fact that before identification can be carried out, extreme care must be exercised to ensure that the measurement data is sampled properly, and that proper preprocessing is done. Identification is far from an automated procedure, so the results can be affected by the skill of the signal processor.

Problems for future work are discussed, along with recommendations, and the identification results are summarized.

83-30 GATE ARRAY LAYOUT USING CADDS2
UCRL-89067/Abstract, April 1983
Submitted to 5th Annual International Computervision User Conference, Miami Beach, Florida September 13-16, 1983

M. D. Pocha
F. D. Cook
J. W. Balch

Gate Array Designs

Abstract

This paper describes enhancements we have made to CADDS2 using defined commands and ICPL programs to aid in the manual layout and checking of gate array designs. We have established a special menu for gate array layout which allows the user access to these enhanced capabilities. Some of these

enhanced capabilities include automatic round off of metal lines to valid routing channels, automatic placement of I/O cells, and rudimentary schematic extraction. These enhancements have made more than a factor of five improvement in our productivity.

83-31 E-FIELD RATIO TELLURIC TECHNIQUES APPLIED TO CAVITY DETECTION FOR OSI OPERATIONS
UCID-19780, April 1983

E. M. Didwall
M. J. Wilt

Cavity Detection

Abstract

Verification of compliance to a Comprehensive Test Ban Treaty (CTBT) may require an On-Site Inspection (OSI) of an area in the USSR where an underground nuclear test may have been conducted. As one of the possible technologies that may be applied by an OSI team, the E-field ratio telluric method for cavity detection is examined. This method utilizes naturally occurring earth currents which are induced by ionospheric and tropospheric electromagnetic activity--no electric field source is provided by the user, thus reducing equipment requirements. Two test surveys were made at the Nevada Test Site. Underground cavities at these locations are expected to have lateral extents of the order of a few 10's of meters and depths less than 300 meters. Telluric measurements indicate that an electrically resistive anomaly exists where the cavity is expected. The anomaly associated with the cavity could be detected even when the survey line did not cross directly over the expected cavity location. Although these experiments do not define the limitations of the method, they do show strong evidence that cavities and chimney formations from an underground nuclear explosion can be detected. Specific goals for further research are suggested.

83-32 ELECTROMAGNETIC COMPATIBILITY OF NUCLEAR POWER PLANTS
UCRL-89102, April 1983
Presented at Second National Colloquium on Electromagnetic Compatibility, Tregastel, France, June 1-3, 1983

H. S. Cabayan

Electromagnetic Compatibility

Abstract

Lately, there has been a mounting concern about the electromagnetic compatibility of nuclear power plant systems mainly because of the effects due to the nuclear electromagnetic pulse, and also because of the

introduction of more sophisticated and therefore nore susceptible solid state devices into the plants. Questions have been raised about the adequacy of solid state device protection against plant electromagnetic interference sources and transients due to the nuclear electromagnetic pulse.

In this paper, the author will briefly review the environment, and the coupling, susceptibility and vulnerability assessment issues of commercial nuclear power plants.

83-33 OVERVIEW OF ACTIVITIES IN MICROWAVE SIMULATION — H. S. Cabayan
UCRL-89103/Abstract, April 1983
Presented at JOWOG 6, Sandia National Laboratory, Albuquerque, New Mexico, June 15-17, 1983

Microwave Simulation Activities

Abstract

In response to recent interest in the effects of high power microwaves on military systems, several U.S. laboratories are building simulation facilities able to generate high power microwaves. In this paper, the characteristics of devices now operating or under construction will be described. The associated technologies such as anechoic chambers, radiating antennas and diagnostics will also be covered.

83-34 EVALUATING THE RESPONSE OF COMPLEX SYSTEMS TO ENVIRONMENTAL THREATS: THE ΣΠ METHOD — G. C. Corynen
UCRL-53399, May 1983

ΣΠ Method

Abstract

The ΣΠ method was developed to model and compute the probabilistic performance of systems that operate in a threatening environment. Although we emphasize the vulnerability of complex systems to earthquakes and to electromagnetic threats such as EMP (electromagnetic pulse), the method applies in general to most large-scale systems or networks that are embedded in a potentially harmful environment. Other methods exist for obtaining system vulnerability, but their complexity increases exponentially as the size of systems is increased. The complexity of the ΣΠ method is polynomial, and accurate solutions are now possible for problems for which current methods require the use of rough statistical bounds, confidence statements, and other approximations. For super-large problems, where the costs of precise answers may be prohibitive, a desired accuracy can be specified, and the ΣΠ algorithms will halt when that accuracy has been reached.

We summarize the results of a theoretical complexity analysis--which is reported elsewhere--and validate the theory with computer experiments conducted both on worst-case academic problems and on more reasonable problems occurring in practice.

Finally, we compare our method with the exact methods of Abraham and Nakazawa, and with current bounding methods, and we demonstrate the computational efficiency and accuracy of ΣΠ.

83-35 EVALUATING THE EFFECTS OF SEISMIC EVENTS ON SYSTEMS IN A NUCLEAR FACILITLY USING THE ΣΠ METHOD — R. M. Thatcher

UCID 19810, May 1983

SIGMA-PI

Abstract

This report describes an application of the SIGMA-PI method to a seismic safety problem. The SIGMA-PI method is a very recent advance in probabilistic modeling and computation. It simplifies the computation of failure probabilities of large systems such as power plant systems in the seismic safety problem which SEISIM, an existing model, evaluates.

For such systems, using no more computer resources, SIGMA-PI calculates estimates of system failure probabilities, whereas SEISIM calculates upper bounds to its estimators of the same probabilities.

SIGMA-PI is actually two methods, SIGMA and PI. PI is a modeling technique which leads to fast and accurate calculations of cut set probability estimators. PI can evaluate large cut sets of dependent basic events without difficulty, whereas SEISIM is drastically limited by the rapid acceleration of computer requirements with respect to cut set size.

SIGMA is a method of rapidly computing system failure probability estimators to a presecribed accuracy from properly set up cut set information. SIGMA attains accuracy by creating disjoint sets from an original class of cut sets that define a system. SIGMA's great speed is due to a new technique that it uses to develop only enough disjoint sets needed for the desired accuracy.

The SIGMA-PI method described in this report has been implemented and tested and is now available for merging with existing seismic safety computer codes.

PI is a necessary technique for developing a computable estimator of system failure probability, but it differes from SEISIM in its modeling of the response (stress) random vector. This changes the definition of the system

probability estimator evaluated by SIGMA-PI from the SEISIM model estimator. Both models display features that require modeling adjustments, but, on balance, more realism can be attained with the SIGMA-PI method.

The Boolean logic used by the original seismic safety problem is too restrictive to handle some special problems, such as:

1. Common manufacturers of components, and
2. "Load sharing" by subsystems of componens.

It might be necessary to develop some special modeling approaches to accommodate some of these problems. The SIGMA-PI method is a flexible modeling tool that provides a feasible way of implementing any such modeling approaches.

83-36 REFLECTIONS ON LAUNCHING FOCUS WAVE MODES FROM CLASSICAL ANTENNA
UCRL-88507, May 1983
Submitted to the IEEE Society of Antenna and Propagation

J. N. Brittingham

Focus Wave Modes

Abstract

In a previous paper an analytical formulation was presented which represented free-space, source-free, three-dimensional, nondispersive classical electromagnetic pulses. These pulses propagate in a straight line at light-velocity. In the present paper the similarity between these pulses to single photons and classical solitary electromagnetic waves is demonstrated.

83-37 MODELING AND TESTING FOR SECOND BREAKDOWN PHENOMENA
UCRL-89147, May 1983
Submitted to Fifth Annual Electrical Overstress/Electrostatic Discharge Symposium, September 27-29, 1983, Las Vegas, Nevada

W. J. Orvis
L. C. Martin
J. H. Yee
C. M. McConaghy
G. H. Khanaka
D. L. Lair

Breakdown
Microwave
Pulse
Semiconductor
Susceptibility
Testing

Abstract

We have developed a computer model that describes charge and heat flow in a semiconductor device. We use this model to investigate thermal

and current mode second breakdown effects and compare our results to some experimentally derived data. Our test environments include both video and microwave pulses of energy.

83-38 A UNIQUE PORTABLE SIGNAL ACQUISITION/PROCESSING STATION

S. G. Azevedo
R. D. Garron

UCRL-88583
Submitted for Real-Time Computer Applications in Nuclear & Particle Physics, Berkeley, CA, May 16-19, 1983

SAPS

Summary

At Lawrence Livermore National Laboratory, there are experimental applications requiring digital signal acquisition as well as data reduction and analysis. A prototype Signal Acquisition/Processing Station (SAPS) has been constructed and is currently undergoing tests. The system employs an LSI-11/23 computer with Data Translation analog-to-digital hardware. SAPS is housed in a roll-around cart which has been designed to withstand most subtle EMI/RFI environments. A user-friendly menu allows a user to access powerful data acquisition packages with a minimum of training. The software architecture of SAPS involves two operating systems, each being transparent to the user. Since this is a general purpose workstation with several units being utilized, an emphasis on low cost, reliability, and maintenance was stressed during conception and design. The system is targeted for mid-range frequency data acquisition; between a data logger and a transient digitizer.

83-39 RECONSTRUCTION TECHNIQUES APPLIED TO DATA INVERSION

R. J. Lytle
A. L. Ramirez

UCRL-89146, May 1983
Submitted to Review of Progress in NDE, Santa Cruz, California, August 8-12, 1983

Algebraic Reconstruction Technique

Abstract

The data-inversion algorithms developed by investigators in the field of tomography can be applied to the problem of determining the structure of the subsurface (e.g., geologic or metallic structures). The three most successful algorithms to date have been modified versions of the tomographer's ART (algebraic reconstruction technique). Projections can be made by probing the structure with electromagnetic waves and recording the magnitude and phase of the received signal for various positions of transmit and receive antennas. The propagation characteristics between transmitter and receiver can be reduced to a linear system. Various reconstruction technique algorithms have been

assessed as to their utility for such problems. Simulations of situations of interest were done to assess the sensitivity of the results to noisy data, to the data collection scenario and to the data processing algorithms. The implementation of these procedures on minicomputers is discussed.

83-40 HOW FOCUS WAVE MODES MIGHT REPRESENT SINGLE PHOTONS AND CLASSICAL SOLITARY ELECTROMAGNETICS
UCRL-89353, May 1983
Submitted to Journal of Applied Physics

J. N. Brittingham

Focus Wave Modes

Abstract

In a previous paper, an analytical formulation was presented which represented free-space, source-free, three-dimensional, nondispersive classical electromagnetic pulses. These pulses propagate in a straight line at light-velocity. In the present paper a combination equivalence principle and image theory are used to derive the time-pulses, electric currents on a fixed-space plane which will launch these fields. The time-functions are observed not to be over complicated.

83-41 SHIPBOARD ANTENNA SYSTEMS EMP DESIGN ALGORITHM (EMPAL)
UCRL-87195, May 1983
Submitted to IEEE 1983 International Symposium on Electromagnetic Capability
Washington, DC, October 24-26, 1983

L. C. Martin
E. J. Bogdan
S. T. Li
J. C. Logan
J. W. Rockway
J. H. Schukantz
D. W. S. Tam

EMP Algorithm
Shipboard Antenna Systems

Abstract

A procedure for the design of shipboard antenna systems against the effects of electromagnetic pulse (EMP is described. Exposure to EMP, especially that from a nuclear burst at high altitudes, can degrade the performance of unhardened communication systems. The design procedure, or EMP algorithm (EMPAL), is a computer-aided iterative process which relies on a blend of experimental and computational techniques.

83-42 DEVELOPING A GATE ARRAY CAPABILITY AT A RESEARCH AND DEVELOPMENT LABORATORY
UCRL-89100
Submitted to Fifth Biennial University/ Government/Industry Microelectronics Symposium, May 25-27, 1983

J. W. Balch
K. W. Current
W. G. Magnuson, Jr.
M. D. Pocha

Gate Array Capability

Abstract

This paper describes our experiences in developing a gate array capability for low volume applications and research and development (R&D) laboratory. By purchasing unfinished wafers and doing the customization steps in-house, we have been able to shorten turnaround time to as little as one week and to reduce the direct costs to as low as $5k per design.

83-43 ASSESSMENT METHODOLOGY FOR THE A-7E: SCALE MODEL COUPLING EXPERIMENTS
UCID-19850, May 1983
Prepared for Defense Nuclear Agency

E. J. Bogdan
D. Wythe

Abstract

Transient electromagnetic measurements were performed on a scale model of the A-7E aircraft as part of the FAANTAEL program concerned with the development of a methodology for assessing Navy aircraft. A 1:10 scale model of the A-7E was developed and tested in configurations which resemble those used in the full-scale aircraft EMP simulation tests at the Air Force Weapons Laboratory. The scale model reproduced the essential external and internal features including an conductive exterior surface, wings that can be folded, and internal compartments. External coupling measurements included horizontal and vertical polarization with wings up and wings down for different modes such as take-off, on ground, and flight. Internal coupling measurements included currents on model cables such as conduit nose to tail and left avionics bay to horizontal tail. The scale-model measurement results were extrapolated to compare with those obtained from the full-scale tests. The external measurements compare favorably (factors of two for peak amplitudes). Internal measurements show greater variation and are consistently higher in peak amplitudes by factors of two to eight.

83-44 DOES KNOWLEDGE ENGINEERING PROVIDE A USEFUL APPROACH TO IMPROVING SITE CHARACTERIZATION

J. Lytle

UCRL-90052, June 1983
Submitted to Rock Mechanics Symposium, June 10-13, 1983

Abstract

Knowledge engineering has been shown to be of merit in successfully providing decisions in certain aspects of medical diagnosis. This technology is going to raise the general level of practice in medical diagnosis. This technology also appears to be applicable to raising the general level of practice in site characterization. Geophysical/geotechnical researchers have identified the need to develop the tools that knowledge engineering provides. However, an attempt by geotechnical personnel to utilize these knowledge engineering methods for describing our methods has not been initiated. This paper is presented to see if others see the need for such a research program. Some of the benefits and potential problems of using this approach are given below.

Benefits

By adopting the knowledge engineering approach, the following benefits are accrued:

1. There would be coordination among site characterizers of their case histories. This would permit the expansion of the codified data base, which would yield more accurate estimates of the relative likelihood of undesirable occurrences.

2. Communication pertinent to a particular site will become well organized, complete and available to all involved. This helps coordinate the efforts of each member of the site characterization team.

3. Use of this information can raise the expertise level of site characterizers in those areas where their expertise is not state of the art. This information thus serves as a very effective consultant.

4. The present inadequate feedback loops for improvement of site characterization performance will be eliminated and mechanism for providing continual updated improvements will be provided.

5. To develop the data base and rationale for interpreting site data, the disparate groups that have knowledge of and interest in particular subsets of data are required to work together, to jointly define the suitable rationale, and to identify gaps in area of needed knowledge. This communication between theorists, laboratory researchers, instrumentation specialists, data processors and site managers will define and update the current state of the art and utility of particular measurements or observations.

Potential Problems

Obviously, knowledge engineering is not a perfect solution to the problem of site characterization. Some possible problems with its application are:

1. No two geological sites will be identical--there will be virtually an infinite number of possible geologic situations to be considered in the general case. This means that the problem will, of necessity, have to be narrowed into a manageable range of possibilities, which may limit its ultimate usefulness.

2. Job security may be threatened. If a computer replaces part of an individual's decision making function, that individual may adversely react to and impede the implementation of the procedure.

3. The legal aspects of a decision partially based upon an analysis performed by a computer need to be defined relative to "current engineering practice."

4. Techniques used in geotechnical investigations are often those in which the investigator is most familiar. Thus, in regard to the data base required to develop a good decision-making analysis code, information may not always be available in the desired quantity or quality.

5. In a human decision-making process, there is always the possibility of creating a new line of decision, or looking at data in a new way (i.e., reevaluating subjectively the "costs," "outcomes," or "probabilities") which a computer code may not be able to do. This means that the computer would best be used as an aid to the expert and not as the final authority in itself.

83-45 ENGINEERING RESEARCH DIVISION
PUBLICATION REPORT, CALENDAR YEAR 1982
UCID-19080-82, June 24, 1983

E. K. Miller
Division Leader
P. L. Livingston
Editor

Publications

Abstract

Each year the Engineering Research Division of the Electronics Engineering Department has issued an internal report listing all formal publications produced by the division during the calendar year.

83-46 ANALYSIS OF A VERTICAL, TUBULAR CYLINDER WHICH PENETRATES AN AIR-DIELECTRIC INTERFACE AND WHICH IS EXCITED BY AN AZIMUTHALLY SYMMETRIC SOURCE

W. A. Johnson

UCRL-88864, Rev. 1, July 1983
Submitted to Radio Science

Air-Dielectric Interface
Currents
Method of moments

Abstract

A method of moments analysis of a hollow, tubular cylinder which perpendicularly penetrates an air-dielectric interface is carried out using a potential-like formulation. Currents are excited on this cylinder by means of an azimuthally symmetric source. Since the thin-wire kernel is not used and real-axis integration of Sommerfeld integrands is employed, this analysis provides an independent check on the Numerical Electromagnetics Code for the case of thin wires which perpendicularly penetrate an air-dielectric interface. Sample results are given for thin wires which penetrate an air-water interface.

83-47 DYNAMIC CHARACTERISTIC OF INTENSE SHORT MICROWAVE PROPAGATION IN AN ATMOSPHERE

J. H. Yee
R. A. Alvarez
D. J. Mayhall
N. K. Madsen
H. S. Cabayan

UCRL-88632, July 1983
Submitted to Journal of Defense

Air Breakdown Threshold
Intense Microwave Pulse

Abstract

The dynamic behavior of an intense microwave pulse which propagates through the atmosphere will be presented. Our theoretical results are obtained by solving Maxwell's equations together with the electron fluid equations. Our calculations show that although large portions of the initial energy are absorbed by the electrons that are created through the avalanche process, a significant amount of energy is still able to reach the earth's surface. The amount of energy that reaches the earth's surface as a function of initial energy and wave shape after having propagated through 100 km in the atmosphere are investigated. Results for the air breakdown threshold intensity as a function of the pressure for different pulse widths and different frequencies will also be presented. In addition, we will present a comparison between the theoretical and the experimental results for the pulse shape of a short microwave pulse after it has traveled through a rectangular wave guide which contains a section of air.

83-48 PHYSICAL MODELING OF EM PROPAGATION OVER NONHOMOGENEOUS TERRAIN

R. J. King

UCRL-89507, July 1983
Presented to AGARD Lecture Series 131,
AGARD-LS-131
ISBN 92-835-1461-0
Turkey, Greece, Belgium
October 18-27, 1983

Modeling

Abstract

To obtain experimental data for comparison with the theoretical results obtained from mathematical groundwave propagation models, it is often expedient to conduct experiments on laboratory models using microwaves. Besides the obsious convenience and reduced cost, practical difficulties encountered in full-scale experiments are avoided (e.g., weather and other uncontrolled parameters such as path nonhomogeneities, earth curvature, buildings, right-of-ways, etc.). There is no need to use exact similitude scaling; the media and geometries are generally chosen to test the limits of the theory's validity.

83-49 MICROWAVE NONDESTRUCTIVE EVALUATION OF COMPOSITES

R. J. King
P. J. Stiles

UCRL-89922, August 7-12, 1983
Proceedings of the Review of Progress in Quantitive NDE Conference
University of California, Santa Cruz
August 1983

Abstract

New reliable and sensitive nondestructive evaluation (NDE) techniques are demanded for quality control, safety, liability and economic reasons. They are essential for measuring defects such as foreign material, voids and cracks, and for measuring changes in material characteristics such as hardness, specific gravity, moisture content, aging effects, composition, thickness, and in the case of anisotropic media, axis alignment, e.g., grain angle. Microwave techniques are rapidly becoming viable tools for nondestructive testing of semiconducting materials (composites, plastics, wood, rubber, etc.), especially when ultrasonic and x-ray methods are limited.

83-50 MAXIMUM ENTROPY (ME) METHODS IN ELECTROMAGNETIC/GEOPHYSICAL/ULTRASONIC IMAGING

R. M. Bevensee

UCRL-89635/Draft, July 1983
Presented at the NATO Workshop on Inverse Methods in Electromagnetics
Bad Windsheim, West Germany
September 18-24, 1983

Maximum Entropy Methods

Abstract

Maximum Entropy (ME) methods of resolving underdetermined electromagnetic images are reviewed. A new nonBurg method of resolving coherent radiators in amplitude and phase is described. Several ME methods in geophysics are described based on Burg's method for spatial array data processing and a Boltzmann method for parameter distributions in the earth. A Boltzmann-ME method is described for resolving anomalies in materials ultrasonically where the data is governed by a Fredholm integral equation of the second kind. Some issues of uniqueness, confidence, and noise are briefly assessed.

83-51 MOLAG: A METHOD OF LINES ADAPTIVE GRID INTERFACE FOR NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS

N. K. Madsen

UCRL-89636, July 1983
Presented to IFIP-TC2-WG2S Conference
Soderkoping, Sweden, August 22-26, 1983

Adaptive Grid
Moving Node Method

Abstract

We describe an adaptive grid or moving node method which can be used to solve systems of nonlinear partial differntial equations. The method is implemented in the form of a method of lines software interface. When this interface is combined with a reliable ordinary differential equation solver, one obtains the capability to adaptively solve systems of partial differential equations. Numerical results are presented.

83-52 ELECTROMAGNETIC FORCES RELATED TO FLASH LAMP FAILURES IN THE NOVA/NOVETTE AMPLIFIERS
UCID-19856, July 1983

J. B. Grant

Flash Lamp Failures

Abstract

A high rate of breakage in flashlamps destined for the Nova and Novette laser system amplifiers has prompted an investigation into the cause. Discussed herein is the possibility that electromagnetic forces (resulting from large currents in these lamps) are bending the anodes and cathodes and, thus, cracking the glass seals. Specifically, the forces resulting from these currents are approximated without indicating whether or not these forces are sufficient to break the seals. The results demonstrate that forces up to .9 N/cm (.514 lbs./in.) directed away from the reflector panel can be distributed along the anodes and cathodes. Also, the scalloped nature of the panel provides good isolation between lamps; the lamp-to-lamp forces are negligible. Time domain plots of the forces are included as well as the computer program which was developed for this investigation.

83-53 THE GEOMETRICAL OPTICS FIELD IN A MAGNETO-ACTIVE RELATIVISTIC ANISOTROPIC PLASMA
UCRL-88115, Rev. 1, July 1983
Submitted to the Physics of Fluids

R. W. Ziolkowski

Geometrical Optics

Abstract

The electromagnetic field in a general inhomogeneous, nonstationary, temporally and spatially dispersive medium is obtained with a geometrical optics approach. The analysis accounts for a magnetic as well as an electric nonlocal conductivity tensor and utilizes convolution forms of those tensors. The magnetic conductivity tensor arises in media such as anisotropic plasmas; the convolution form of the nonlocal conductivity tensors follows naturally from the orbit integral solution of the collisionless Fokker-Planck equation. The interrelationships of the geometrical optics descriptions deduced from the convolution and other nonlocal physics representations are also examined. It is shown, for instance, that terms appear in the amplitude transport equation derived from the convolution description that are not obtained when central averaged forms are used to describe the nonlocal physics. These additional terms account for a spreading of the rays in $(\vec{k},\omega)$-space. This is in addition to the usual factor that accounts for the spreading of rays in $(\vec{x},t)$-space. The results of the geometrical optics analysis are applied to a general magneto-active, relativistic, anisotropic plasma.

83-54 MICROWAVE KINOFORM FOR MAGNETIC FUSION
UCRL-89603, July 19, 1983
Presented at the SPIE Annual Technical Symposium

N. C. Gallagher, Jr.
D. W. Sweeney

Microwave Kinoform

Abstract

A microwave kinoform that modifies both the phase and polarization of an incident wavefront has been designed. This kinoform for the TMS-U magnetic fusion experiment has been fabricated and tested. The design procedure, method of fabrication, and experimental test results are discussed.

83-55 A GENERAL NUMERICAL BOUNDARY CONDITION METHOD FOR HYPERBOLIC SYSTEMS
UCRL-89686, August 1983
Submitted to J. Comp. Physics

N. Madsen

Hyperbolic Systems
Quasi-linear

Abstract

A new technique for treating boundary conditions for systems of linear and quasi-linear hyperbolic partial differential equations is developed. The technique is applicable to finite difference, collocation and Galerkin methods in both one and two spatial dimensions. The basic technique is easily implemented even into existing software for nonlinear systems of equations which use implicit and/or higher order methods. The actual implementation of the technique into an existing softwae package is illustrated and numerical results are presented for a small linear system and for the quasi-linear gas dynamics equations.

83-56 NUMERICAL MODEL OF ELECTROMAGNETIC SCATTERING OFF A SUBTERRANEAN 3-DIMENSIONAL DIELECTRIC
UCID-19860, August 1983

C. G. Dease
E. M. Didwall

Electromagnetic Model
Low Frequency
Scattering
Voids

Abstract

As part of the effort to develop On-Site Inspection (OSI) techniques for verification of compliance to a Comprehensive Test Ban Treaty (CTBT), a computer code was developed to predict the interaction of an electromagnetic (EM) wave with an underground cavity. Results from the code were used to evaluate the use of surface electromagnetic exploration techniques for detection of underground cavities or rubble-filled regions characteristic of underground nuclear explosions.

83-57 AN OVERVIEW OF DIGITAL IMAGE PROCESSING
UCRL-89706, August 1983
Submitted to 26th Midwest Symposium on Circuits and Systems, Puebla, Peu., Mexico

R. E. Twogood
R. J. Sherwood

Digital Image Processing

Abstract

This paper presents an overview of the field of digital image processing. Particular attention is devoted to the fundamental concepts involved in image processing, including image digitization and typical goals. Some of the most important image processing algorithms are also discussed with emphasis on techniques that are applicable across a broad range of applications.

83-58 MATCHING THE HOT-CARRIER DETECTOR

J. N. Brittingham
L. F. Jelsma

UCRL-89707, August 1983
Submitted to National Radio Science Meeting, URSI, Boulder, Colorado, January 11-14, 1984

Hot-Carrier Detector

Abstract

Because of its large output signal voltage as compared to other microwave detectors, the hot-carrier detector is being developed at Lawrence Livermore National Laboratory as a high field detector. This detector is a germanium crystal which is used to measure the electric field. When placed in a rectangular waveguide, a special matching method is required because the old approaches of introducing metal objects into the guide might initiate arcing for high fields. Therefore, to overcome this, we have chosen dielectrically-filled guide sections as a matching technique. The method is to use lossless, homogeneous, isotropic dielectrically-filled rectangular guides which fill the entire guide. The first two matching procedures which we investigated was the single dielectric slab and double dielectric slabs. In the second case, there is a void between the two slabs; also between the last and load.

We chose to study these problems by writing a numerical code which uses the scattering matrix theory for dielectrically-filled rectangular guides. This code uses the analytical formulation of the matching section along with the measured reflection coefficient data to predict the cascade effect. The code was experimentally verified for the single slab matching section. Then the code was used to assess the bandwidth of both matching techniques.

83-59 BLOCK ADAPTIVE FILTERING FOR COMPUTATIONAL COMPLEXITY SAVINGS: A TUTORIAL

G. A. Clark

UCRL-89666, August 1, 1983
Submitted to National Electronics Conference, October 23-26, 1983, Chicago, Illinois

Block Adaptive Filter
Computational Complexity
Frequency Domain
Sectioning
Time Domain

Abstract

Frequency domain adaptive filtering has received considerable attention in the last few years, because of the computational savings offered

by the fast Fourier transform (FFT). This paper describes a general filter structure, the block adaptive filter, which contains the time and frequency domain adaptive filters as special cases.

83-60 INTEGRATION OF THE SAFETY PARAMETER DISPLAY SYSTEM IN CONTROL ROOM DESIGN — L. R. Peterson

UCRL-89725, August 1, 1983
Submitted to Transactions of the
Reactor Operations Conference,
ANS Reactor Operations Division
Topical Meeting, Scottsdale, Arizona

Safety Parameter Display System

Abstract

Installation of the Safety Parameter Display System (SPDS) can be used as a means to advance the technical data display capabilities in the control room and to modify the role of the operators. Successful addition of the SPDS requires management decisions on changes of the operators' role and duties. Collaboration and communication between system designers and operators is essential during design of the SPDS. Integration of the SPDS with operating procedures and operator training is required to fully utilize its technical capabilities.

83-61 LABORATORY DETERMINED TRANSPORT PROPERTIES OF BEREA SANDSTONE — W. D. Daily, W. Lin

UCRL89758/Abstract, August 26, 1983
Submitted to EOS, Proceedings Amer.
Geophys. Union Fall Annual Mtg. Amer.
Geophys. Union, San Francisco, California
December 6, 1983

Transport Properties

Abstract

Laboratory measurements of the electrical resistivity (ρ), water permeability (k), and compressional wave velocity (Vp) are reported for both intact and fractured Berea sandstone samples as a function of temperature from 20°C to 200°C and effective pressure (P_e) from 2.5 MPa to 50 MPa. For the intact sample, Vp increases from 3.52 km/s to 4.16 km/s as P_e goes from 3 to 50 MPa. With increasing temperature Vp decreases at a rate of about 3% per 100°C at P_e of 5 MPa and about 1.5% per 100°C at P_e of 38 MPa. Data from the fractured sample are qualitatively similar but velocities were about 10% lower. For both intact and fractured samples, ρ increases less than 15% as P_e increases from 2.5 to 50 MPa. Although both samples show a larger decrease in resistivity with increasing temperature, most of this change is attributed to

the decrease in resistivity of the pore fluid over that temperature range. For both samples, k decreases with increasing pressure and temperature. The intact sample permeability varies from 23 md at 3 MPa and 20°C to less than 1 md at 50 MPa and 150°C. The fractured sample permeability varies from 676 md at 20°C and 3 MPa to less than 1 md at 40 MPa and 190°C. The effect of the fracture on k vanishes after several pressure cycles and above about 100°C. These laboratory data are used to demonstrate the possibility of using resistivity and velocity measurements to estimate in-situ permeability of a reservoir.

83-62 THE DISCRETE PROLATE SPHEROIDAL FILTER AS A DIGITAL SIGNAL PROCESSING TOOL
UCRL-89858, September 1983
Submitted to IEEE Trans An Acoustics, Speech, and Signal Processing Society

J. D. Mathews
J. K. Breakall
G. K. Karawas

Eigenvalue
Eigenvector

Abstract

The discrete prolate spheroidal (DPS) filter is one of the class of nonrecursive finite impulse response (FIR) filters. The DPS filter, first introduced by Tufts and Francis (1970), is superior to other filters in this class in that it has maximum energy concentration in the frequency passband and minimum ringing in the time domain. We give a mathematical development of the DPS filter properties, provide information required to construct the filter, and compare the properties of this filter with those of the more commonly used filters of the same class. We note that use of the DPS filter allows for particularly useful statements of data time/frequency resolution "cell" values and, that overall, it forms an especially useful tool for digital signal processing.

83-63 CAD/CAM: NEW DEFINITIONS, NEW DIRECTIONS
UCRL-89859, September 1983
Submitted to IEEE Second Annual Workshop onInteractive Computing: CAD/CAM: Engineering Education

L. Hatfield

CAD/CAM

Abstract

The definitions of CAD/CAM have shifted over the years, as CAD changed from a focus on drafting to design. Now CAD is becoming Computer-Aided Engineering (CAE). This trend to a more inclusive definition is examined, with the role which technology plays being looked at in some detail. Trends in technology and CAE are considered. Finally, the impact of these changes on education in electrical engineering departments is considered.

83-64 MODELING AND TESTING FOR SECOND BREAKDOWN PHENOMENA

W. Orvis

UCRL-89147, September 1983
Submitted to Electrical Overstress/
Electrostatic Discharge Symposium

n+-p-n-n+

Abstract

We have developed a number of computer models at the Lawrence Livermore National Laboratory, to study the operation of semiconductor devices during an Electromagnetic Pulse (EMP) induced transient. During the last year, two of these models have been giving significant results. A simplified transistor model has been used to calculate second breakdown effects in a transistor like structure. This simple, n+-p-n-n+ one-dimensional model uses analytical approximations in all regions except for the n-region where numerical solutions are obtained. Using this model, we have investigated the differences between current mode and thermal mode second breakdown (described previously Ref. 1) and a switching effect between current mode and thermal mode second breakdown.

83-65 ENGINEERING RESEARCH 1982

Edited by:
C. Minichino
P. L. Phelps

UCID-19888, September 1983

Engineering Research Activities

Abstract

Under the general direction of H. C. McDonald, associate director for Engineering, Engineering Research funds are provided by the Laboratory to the EE and ME Departments to develop advanced technology capabilities to meet long-term needs, principally of weapons related programs. The EE portion of the program, called Electronics Engineering Research (EER), is administered by the Engineering Research Division. This report is a description of EER activities for FY 1982.

83-66 MODELING ANTENNAS NEAR TO AND PENETRATING A LOSSY INTERFACE

G. J. Burke
E. K. Miller

UCRL-89838, September 1983
Submitted to AGARD Lecture Series
No. 131
North Atlantic Treaty Organization (NATO)
Turkey, Greece, Belgium
October 19-28, 1983

Abstract

In this paper, we describe a technique for modeling wire objects interacting across or penetrating the planar interface which separates two half spaces. The moment-method treatment is employed, based on the thin wire approximation to the electric-field integral equation, with the effect of the ininterface included via the usual Sommerfeld integrals. The computation time asassociated with evaluating the latter is substantially shortened by using an interpolation based technique plus asymtotic field expressions. Although developed specifically for the wire problem, the procedure is also applicable, with slight modification, to modeling surface objects as well. Special account isis taken of the charge discontinuity that occurs at the point a wire penetrates the interface. Example calculations are shown for the antenna-ground stake problem; monopole antenna driven against a simple ground screen; the fields of buried objects; and a simple EMP simulator.

83-67 REVIEW OF THE 3RD BIENNIAL CONFERENCE ON REAL-TIME COMPUTER APPLICATIONS IN NUCLEAR AND PARTICLE PHYSICS

Dennis W. O'Brien

UCRL-89915, October 1983
Submitted for the 1983 IEEE Nuclear
Science Symposium in San Francisco

Real-Time Computer

Summary

The community of engineers, programmers, and physicists who support data-acquisition, control, and post processing activities in nuclear and particle physics had an opportunity to meet in Berkeley on May 16-20, 1983 for the "Conference on Real-Time Computer Applications ...". It was the third such conference, held every other year. In May 1979 Dennis Perry of Los Alamos Scientific Laboratory hosted the "Topical Conference on Computerized Data-Acquisition Systems in Particle and Nuclear Physics" in Santa Fe. David Hensley brought the conference to Oak Ridge in May 1981. And this year's conference underwent a name change by it's host, Creve Maples of Lawrence Berkeley Laboratory, but remained very much the same in spirit and direction.

83-68 ENGINEERING WORKSTATIONS IN THE NATIONAL LABORATORY
UCRL-89894, October 1983
Submitted for the 1983 IEEE Nuclear Science Symposium in San Francisco

D. W. O'Brien

Summary

A great deal has been said of how computer-aided engineering (CAE) tools, and particularly engineering workstations as vehicles for those tools, can benefit the engineering workplace. In attempting to characterize the activities of the "typical" engineer, as with time-and-motion studies, one questions how much of this benefit is conjecture and how much can be realized. Hewlett-Packard, a leading supplier to the engineering community, has been citing a figure of 20%/80% as the ratio of time that engineers spend performing what is thought of as engineering activities (analysis, simulation, synthesis, and design) vs. the time an engineer spends on communication functions of various kinds, including writing reports, attending meetings, corresponding with coworkers.

83-69 3rd DOE WORKSHOP ON COMPUTER-AIDED ENGINEERING ABSTRACTS
CONF-8310160
Abstracts submitted to the 3rd DOE Workshop on Computer-Aided Engineering, October 13-14, 1983 held at Lawrence Livermore National Laboratory

L. Hatfield
D. O'Brien
M. Pocha
F. Cook
J. Balch
G. Corynen
W. Magnuson
H. W. Chin
B. M. McWilliams
F. Mitlitsky
J. C. Whitehead
L. L. Wood

DOE Workshop
Computer-Aided
iCAEn

Abstract

Electronics Engineering CAE at LLNL

L. Hatfield

The Electronics Engineering Department at Lawrence Livermore National Laboratory is implementing a Computer-Aided Engineering (CAE) plan as part of its efforts to increase engineering capability. This plan has two major components to it: providing a broad range of computer-based tools to assist the

engineer in his/her work and providing effective computer power to the engineer to support these computer-based tools.

Appropriate tools are developed or imported by five thrust areas, which have the more general charter to develop the technology base associated with their areas. The tools will cover essentially all aspects of an engineer's job, including such areas as modeling/simulation, software development, computer-aided design, project management, analysis, project communication, and documentation. An overview of the currently available tools and plans for additional tools will be given.

Providing effective computer power to the engineer has been the focus of much of this year's efforts. To augment the power provided by the central computing systems and to provide more interactive and user-friendly computing, we have developed a plan emphasizing super-minicomputers, local area networks, and workstations. Ties are being provided to other appropriate systems, such as CAD/CAM systems, and other local networks. These plans and the current state of implementation will be highlighted.

Abstract

iCAEn, Livermore's Integrated Computer-Aided Engineering Network

D. W. O'Brien

Consistent with the Laboratory's CAE Plan and the objective of getting effective computer power and computer-based tools to engineers, the Electronics Engineering Department of Lawrence Livermore National Laboratory has established iCAEn, the Integrated Computer-Aided Engineering Network. iCAEn is intended to cut across organizational and cultural bounds to provide 1) a pipeline between engineering, design, drafting, and manufacturing activities, and 2) a highly accessible communications facility for engineers to distribute and maintain tools, disseminate information, share data, and develop professional colleagues (a real need in a matrixed support organization).

Engineering divisions operate their computers autonomously, participating in iCAEn as peers, in a casual fashion. It is not an objective of the iCAEn network to provide load balancing, resource sharing, or terminal-to-computer circuit switching, as much as it is to facilitate the trafficking of information between organizations who are sufficiently supported with computer power.

iCAEn is an operational facility, currently providing needed services in Building 131 at Livermore. It is a loosely coupled network of unclassified VAX computers, LSI-11 microcomputers, and ComputerVision CAD systems using ethernet and point-to-point technologies. It is predominantly a DECnet environment with various "gateways" to permit access from non-DEC workstations and CAD systems, and to facilitate extension of the network over a variety of media to nodes on and off site.

iCAEn offers substantial benefit to the Laboratory in fostering access to information, new working relationships, rapid response to programmatic needs with high level engineering tools and expertise, and better communication across organizational and project discipline boundaries.

Abstract

Gate Array Design Activity at LLNL

M. D. Pocha, F. D. Cook, and J. W. Balch

Work on design and fabrication of gate arrays in CMOS technology has been going on for approximately two years at LLNL. Plans are being made to expand this effort into high speed ECL gate arrays as well. We are using CAD tools in the areas of electrical design, layout, and checking. These tools help us to meet the unique requirements of an R&D facility for low cost, low volume, rapid turnaround custom integrated circuits.

This paper will describe the gate array activity with emphasis on our existing CAD tools and our plans/needs for future extension of these tools.

Abstract

Towards an Efficient Probabilistic Approach for Testing VLSI Circuits

G. C. Corynen

In many applications, the failure of a single integrated circuit can have catastrophic consequences. A capability to thoroughly test integrated circuits is thus important to the designers and manufacturers of such circuits. Unfortunately, resources required to test circuits currently grow exponentially as the size of the circuits is increased. As a results, statistical methods are gaining popularity as a means to circumvent statistical methods are gaining popularity as a means to circumvent combinatorial approaches while providing a sufficient degree of confidence concerning the performance of units tested by such methods. In this paper, we summarize the essential techniques currently used, and we propose a new probabilistic method based on recent developments in the efficient computation of large-scale system performance. We also show how new superfast algorithms can be applied to ease the testing problem.

Abstract

Introducing Gate Arrays to Design Engineers

W. G. Magnuson, Jr., J. W. Balch, and M. D. Pocha

At LLNL, we have several hundred design engineers supporting a variety of research programs. Designs generally require fast turnaround (a few weeks to a few months) and very low volumes (1 to 25). Design costs must

be kept to a minimum. Because the Laboratory is a research and development facility with a diversity of digital design projects and design approaches, the training planned. We started by identifying key projects which seemed to have a high likelihood of being able to use gate arrays. We then cnducted one-on-one interviews with design engineers in these projects. These interviews were followed up with a written survey.

Out of these sessions and responses, we formulated a training plan. To all engineers and designers at LLNL, we first mailed a short memo describing the gate array capabilities we had developed to date. We also announced a two-part training course:

1. A seven-hour seminar consisting of two half-day sessions, and
2. An eight-week course meeting three times per week for one hour plus a three-hour laboratory session each week.

In both the seminar and the course to follow, we had several objectives. Some of these objectives were to:

1. Encourage personnel development,
2. Change work habits,
3. Dispel myths about gate array design capabilities and limitations of CMOS gate arrays, and
4. Move designers towards designing on silicon.

Sixteen designers were selected to participate in the first class. Four groupings of four were made and each group worked as a design team for the course projects.

Lecture notes were passed out for each of the lectures and modest homework assignments were given. The bulk of the homework was associated with the laboratory sessions. The laboratory sessions scheduling was up to each group, so they could adjust to their work schedules. Each group was to do two designs. Each design resulted in a packaged chip being returned to the group. The design, simulation, layout, digitization, PG tape, metalization, testing, and packaging schedules were very tight for the two project chips for each group. Only one group fell behind and that was because they got a little too ambitious.

Our experiences with teaching this course will be discussed together with our future course plans.

Abstract

Wafer-Scale Laser Pantography: V. Hour-Scale Start-To-Finish Interconnection of VLSI CMOS Gate Arrays

H. W. Chin, B. M. McWilliams, F. Mitlitsky, J. C. Whitehead and L. L. Wood

We have previously created MOSFETs and small-scale integrated circuits composed of them with sequences of micron-scale pyrolytic chemical

reactions on silicon substrates energized with focused, switched laser beams. Some aspects of this laser pantographic approach are extended in the present work to interconnect components of a 5,000 active device CMOS gate array with metal lines.

Discretionary metallization processes are reported which employ a 515 nm laser beam focused to micronOscale spot sizes to react silane, nickel carbonyl and tungsten hexafluoride gases on the upper surface of the CMOS gate array wafers to directly and very rapidly deposit micron-width polysilicon, nickel and tungsten lines, respectively. This direct-writing approach requires neither masks or resist, admits erasing, and forms high quality ohmic contacts to underlying diffusion regions without extended high temperature processing.

Comprehensive computer control of this processing has been emphasized. The interconnections to be made are specified to the system via standard format data files. The focused laser spot is rapidly panned relative to the wafer and synchronously amplitude-modulated, under computer control. The patterning chamber is loaded (and evacuated) with program-specified pressures and compositions of wafer-cleaning and reaction gases by means of computer-actuated valves and sampled gauges, permitting the complete processing of a gate array wafer to occur in a single reaction chamber without manual intervention.

Advantages of this approach include the hour-scale implementation of large gate array designs, in-situ computer-driven circuit testing and post-testing processing passes to correct detected circuit defects.

83-70 BASALT NUCLEAR WASTE REPOSITORY REMOTE SENSING USING ELECTROMAGNETIC TECHNIQUES
UCRL-54362, October 1983

W. D. Daily
H. M. Buettner

Basalt Waste

Abstract

The electromagnetic permittivity and attenuation rate of basalt from the Near Surface Test Facility of the Basalt Waste Isolation Project at Hanford, Washington have been measured in the laboratory as a function of water content at frequencies from 25 to 1000 MHz. Both the permittivity and attenuation rate are strongly related to water content of basalt in this frequency range. Completely dehydrated, the rock has a relative permittivity of about 8 which is independent of frequency and an attenuation rate (inverse skin depth) of 0.04 and 3.2 m^{-1} at 25 and 1000 MHz, respectively. When completely saturated by tap water to 6% by volume, the relative permittivity ranges from 16.5 to 10.0 and the attenuation ranges from 0.3 to 5.5 m^{-1} between 25 and 1000 MHz. The data indicate that high frequency electromagnetic remote sensing techniques such as used in radar, cross borehole tomography, and borehole logging may be useful in characterizing proposed basalt repositories and monitoring established waste repositories. Electro-

magnetic methods are particularly suited to delineating water content of the rock, and when completely saturated, crack and pore porosity of the rock mass within a repository.

83-71 USER'S MANUAL SIG, A GENERAL PURPOSE SIGNAL PROCESSING PROGRAM
UCID-19912, October 25, 1983

Darrel Lager
S. Azevedo

SIG

Abstract

SIG is a general-purpose signal processing, analysis, and display program. Its main purpose is to perform manipulations on time--and frequency-- domain signals. However, it has been designed to ultimately accommodate other representations for data such as multiplexed signals and complex matrices. Many of the basic operations one would perform on digitized data are contained in the core SIG package. Out of these core commands, more powerful signal processing algorithms may be built.

83-72 NUMERICAL ELECTROMAGNETICS CODE-METHOD OF MOMENTS USER'S GUIDE SUPPLEMENT FOR NEC-3 FOR MODELING BURIED WIRES
UCID-19918, October 1983

Gerald J. Burke

Buried Antennas
Antenna Ground Screens
Ground Stakes

Abstract

NEC-3 is a version of the Numerical Electromagnetics Code - Method of Moments that has been extended to model wires that are buried or penetrate the ground-air interface. Fields in the presence of an interface are obtained by interpolation or least-squares approximation using tables generated by an auxiliary program SOMNTX which evaluates Sommerfeld integrals. Asymptotic approximations for the field are used at larger distances. This approach is similar to that used in NEC-2 for wires above the interface, but now includes reflected field below the interface and field transmitted across the interface.

83-73 MAXIMUM ENTROPY RECONSTRUCTION OF A VOLUME ANOMALY FROM PULSE SCATTER DATE — R. M. Bevensee

USRL-89298, October 1983
Review of Progress in Quantitative NDE,
Santa Cruz, California
Also for the Proceedings of the Review of Progess in Quantitative Nondestructive Evaluation, Plenum Press (to be published)

Abstract

The Boltzmann (non-Burg) Maximum Entropy method described last year[1] is applied to the problem of inferring the shapes of extremely underdetermined volume anomalies from scattered waves on the incident (plane) wave side of the volume probed. The relevance of the entropy concept for this problem is shown. Ths efficacy of two versions of the method ("radiating sourc" and "ray path") is indicated by two-dimensional synthetic-data problems involving only scalar wave displacement and no shear/compressional wave mixing.

83-74 THE MAXIMUM ENTROPY FORMULATION OF INVERSE PROBLEMS OF NDE — R. M. Bevensee

UCRL-88320, October 1983
Review of Progress in Quantitative Nondestructive Evaluation, Vol. 213,
Edited by D. O. Thompson and D. E. Chimenti,
Plenum Press, 1983, pp. 937-947

Abstract

This paper introduces the Maximum Entropy method of resolving underdetermined objects (flaws or inclusions) by a physicists' brand of nonlinear processing of the image data. We survey three areas of research: (1) synthetic aperture i8maging to resolve three dimensional flaws, with the aid of selective back projection, (2) scattering from anomalies according to the inhomogeneous Fredholm integral equation of the second kind, and (3) ultrasonic flaw characterization by the boundary integral equation method. A simple example is offered to illustrate the potential resolving power of the ME method for problems in area (2). We present some criteria for effective ME inversion.

83-75 A RELIABILITY CONFIDENCE METHODOLOGY FOR COMPLEX SYSTEMS

R. M. Bevensee

UCRL-88319, October 1983
Review of Progress in Quantitative Nondestructive Evaluation, Vol. 2A, Edited by D. O. Thompson and D. E. Chimentic, Plenum Press, 1983, pp. 635-641

Abstract

The problem of assessing the reliability R of an internal for system probability of failure and the confidence C in that realiability in terms of R-C internals of the components is solved with the aid of Markoff's Method. The analysis is applied to ancient engine failure.

83-76 NUMERICAL MODELING TECHNIQUES FOR HALF-SPACE (GROUND) PROBLEMS

E. K. Miller
G. J. Burke
R. J. King
N. C. Mathurt

UCRL-89613, October 18-27, 1983
Submitted to AGARD Lecture Series 131 Turkey, Greece, Belgium
AGARD-LS-131
ISBN 92-835-1461-0

Abstract

The capability of modeling antennas near to and penetrating a plane boundary such as the earth-air interface has long been needed. While the analytical solution of this problem is well established, its rigorous computational treatment is only now becoming practicable. In this presentation, we outline the basic problem, describe a numerical approach to modeling it, and present some representative results. For simplicity, our discussion is addressed to wire objects only, although the method used to include the interface is more general, being applicable to conducting surfaces and penetrable bodies as well. The computer model described below is incorporated in NEC (Numerical Electromagnetic Code), a widely used modeling code.

83-77 ASYMPTOTIC EVALUATION OF HIGH FREQUENCY FIELDS NEAR A CAUSTIC--INTRODUCTION TO MASLOV'S METHOD
UCRL-88304, October

R. W. Ziolkowski
G. A. Deschamps

Abstract

The purpose of this article is to bring to the attention of radio engineers and scientists concerned with high frequency wave propagation some methods, due in part to V. P. Maslov [Maslov, 1972; Maslov and Fedoryuk, 1981], which have been applied mainly to physics as a bridge between classical and quantum mechanics. Their main application is to evaluate the field near a caustic, where geometrical optics (GO), even augmented by the Geometrical Theory of Diffraction (GTD) [Keller, 1962], fails. No attempt will be made to prove all statements. Rather, we will illustrate their application by simple problems. We wish to emphasize ideas rather than rigor. Furthermore, although the method is quite general, only the two-dimensional wave equation will be considered here. The examples chosen do not demonstrate adequately the power of the method, but are more transparent as illustrations of the various steps involved.

83-78 SILJAK, DRAGO, SUBCONTRACT 15586

S. Drago

Abstract

The object of this report is to present a "piece-by-piece" LQG design for large-scale systems. The proposed design procedure is developed for a hierarchical (block triangular) representation of the system, which is obtained via a graph-theoretic decomposition algorithm. The estimator is built as a union of low-order optimal estimators attached to each individual subsystem sequentially going from the top to the bottom of the hierarchy. As the subsystem state estimates become available, optimal controllers can be designed for each subsystem separately resulting in an overall closed-loop system which is stable and suboptimal. This design process offers a considerable reduction of both off-line and on-line computations, which is especially effective in large sparse systems.

83-79 PERFORMANCE OF BEVERAGE ANTENNAS AT LOW ANGLES
UCID-19925 Rev., November 1983

S. J. Burke
R. J. King
R. J. Lytle
E. K. Miller

Beverage Antennas
Antenna Modeling

83-80 DISCUSSION OF MOMENT METHOD CODES WITH EMPHASIS ON APERTURE COUPLING
UCID 19932 November 1983

J. B. Grant

Electric Field Integral Equation

Abstract

In this communication are discussed four numerical codes treating coupling through apertures to wires or other objects. Our intent is to point out advantages and disadvantages of these codes, in which recent interest has been shown. The codes discussed are time harmonic codes utilizing either an electric field integral equation or a reaction integral equation formulation (see, for example, Harrington, 1961). The four codes examined are: a triangular patch moment method code under development by Wilton (D. Wilton, personal communication, 1982) based on the work of Rao, et al., (1982) and of Glisson and Wilton (1980); a rectangular patch code by Newman (1981) based on the work of Newman and Pozar (1978; 1980); a body of revolution moment method code by Schuman (1980); and a hybrid code by Taflove and Umanshankar (1981; 1982) which uses both a moment method technique and a finite difference technique. Each code is examined with respect to the geometry of the scatterers for which it can be used, the solution method used and with respect to various numerical considerations.

83-81 MICROWAVE SUSCEPTIBILITY EXPERIMENTS AT S AND X BAND
UCRL-90126, December 1983
Submitted to IEEE Transactions on Antennas and Propagation held at the Baltimore Hilton, July 2-6, 1984

C. F. McCongaghy

Abstract

We have tested both integrated circuits and discrete devices at a variety of microwave pulse widths. We have been conducting experiments to determine the susceptibility of various components to microwaves at both S and X band. Tests have been performed on receiver components such as transmit-receive tubes to determine the amount of spike leakage that occurs both inband as well as out of band for these devices. Our emphasis in these experiments has been on high power (1 kw - 100 mw) and short pulse widths (100 ns and less). In addition to the receiver component tests, we have tested some 8 k CMOS ram chips at S band to determine the energy of burnout versus pulsewidth over the range of 10 ns to 300 ns. We have noticed a decrease in energy at the shorter width.

83-82 B-DOT MICROPROBES

D. R. Ciarlo
D. A. Fromme
D. Okubo

UCRL-90121 December 1983
Sumbitted to 1984 Nuclear EMP Meeting
Baltimore, MD, July 2-6, 1984

Abstract

We have designed and fabricated miniature sensors for the measurement of fast transient magnetic fields. These sensors, commonly called B-dot microprobes, consist of two small loops differentially connected for common mode noise rejection. Loop diameters from 0.2 mm to 5.6 mm have been used. The sensitivity of these probes is proportional to the product of the loop area and the rate of change of the magnetic field. Probes with sensitivities ranging from 7×10^{-8} volts/tesla/sec to 3×10^{-5} volts/tesla/sec have been fabricated. The frequency response of the probes approaches 1 GHz and is limited primarily by the off-chip connections.

We have used microfabrication techniques to fabricate these B-dot microprobes on ceramic substrates which are 1 inch by 1 inch and .01 inch thick. A laser is used to trim the ceramic after the probes are fabricated in order to minimize the amount of material in the probe region.

Three layers of aluminum metalization are used for the conductors and shielding. Polyimide layers are used for the dielectric. By using five micrometer thick polyimide, a signal voltage as high as several hundred volts can be tolerated.

We have used the NETTWO circuit code to simulate the electrical performance of these probes. Results of this simulation along with actual experimental data will be presented.

83-83 AN EVALUATION OF THE MODELS DEPICTING EMP INDUCED FAILURES IN SEMICONDUCTOR DEVICES

W. Orvis
G. Khanaka
J. Yee

UCRL-90125, December 1983
Submitted to IEEE Transactions on
Antennas and Propagation held at the
Baltimore Hilton, July 2-6, 1984

Abstract

We have investigated a number of the models available for modeling second breakdown and failure in semiconductor devices. We find that there are basically two types of models, simple analytic models and more complex numerical models. The analytic models are all generalizations of the Wunch-Bell model and, as such, involve only thermal effects. The numerical models range in complexity from simple heat flow calculations to multidimensional heat and charge carrier flow models. Both of these approaches have their own merits, problems and sources of error. We have evaluated these models, listing their relative merits and problems, enumerated their sources of error and compared them to measured error distribution and data.

83-84 IMPROVED FORMULATION FOR FOCUS WAVE MODES-T.E. J. N. Brittingham
UCRL-90073 December 1983
Submitted to IEEE/AP-S Symposium and
National Radio Science Meeting
Copley Place, Boston, MA June 25-28, 1984

Abstract

In the preceding paper ("Focus Wave Modes in Homogeneous Maxwell's Equation: Transverse Electrical Moded," J. N. Brittingham, J. Appl. Phys., Vol. 54, No. 3, March 1983. pp. 1179-1189) analytical formulations for three-dimensional, source-free, focused, electromagnetic packet were given. These pulses moved at light velocity. They are truly three-dimensional function because they decrease in the three spatial coordinates away from the moving pulse center. Because of the focused nature, we choose to call them Focus Wave Modes, abbreviated FWM. They are the first three-dimensional solitary solution to homogeneous Maxwell's equations. This formulation contained seven parameteric constants and two supplemental equations which interrelated these quantities. Their asympotic fields magnitude is similar to those for the stationary free-space dipoles.

In this paper an improved analytical expression for this identical problem is presented. This formulation has four parameters and no supplemental equations. Also the electromatic energy of these packets will be discussed. By using a procedure which is used on the stationary dipoles, we can obtain finite-energy solution for both solutions. This approach is to confine the solution-space to volume with finite extent. This procedure also will be demonstrated here.

83-85 TIME DOMAIN FINITE ELEMENT METHODS FOR EMP COUPLING
N. K. Madsen
J. C. Peterson
UCRL-90117, December 1983
Submitted to Nuclear EMP Meeting
(NEM 1984) to be held at the
Baltimore Hilton, July 2-6, 1984

Abstract

Over the past two years we have explored the use of finite element methods for solving electromagnetic coupling and scattering problems in the time domain. Finite element methods are well known for their ability to readily solve problems where complicated irregular structures or objects are involved.

We have developed a two dimensional time domain code, GEM2D, which implements a Galerkin finite element method for solving Maxwell's curl equations. We will discuss the advantages and disadvantages of our finite element code. We will also show results for several nontrivial EMP coupling problems which will demonstrate the versatility of the finite element techniques.

83-86 TRANSIENT COUPLING INTO CAVITY-BACKED APERTURES
UCRL-90130 December 1983
Submitted to Nuclear EMP Meeting
(NEM 1984) to be held at the
Baltimore Hilton, July 2-6, 1984

J. Breakall
J. Morrison
J. Hudson
R. King

Abstract

Experimental techniques and results are presented for electromagnetic coupling to test objects at frequencies up to 2.5 GHz. The LLNL EM transient range (which has been extensively used to test scale models of aircraft, ships, and EMP simulators) was used for these present coupling measurements. Extensive experiments have been conducted on aperture coupling into cavities with and without wires inside. Excitation was provided with a very short 1 kilovolt pulse (370 ps) radiated from a 3m high monocone antenna over a 10 x 10m ground plane on which the test object lies. Results were obtained using extensive data acquisition and signal processing capabilities which have been developed over the past several years. Considerable insight into individual system parameters has been obtained from the separation of coupling effects due to the aperture, the cavity, and the wire inside. It was found that the lowest frequency where significant coupling occurs is where the aperture circumference is about one wavelength. Also, the aperture Q is greatest for apertures having a large aspect ratio. Power coupled to a wire inside a cavity decreases as the wire moves further away from the aperture. The transfer ratio near the aperture can exhibit gain, i.e., fields just inside the aperture can be greater than the incident field. The physical properties of the aperture produce the most significant coupling effects as compared to those of the cavity and wire. Discussion of the extension of this work to more complicated structures is also given.

83-87 A GENERALIZED NETWORK APPROACH FOR ASSESSING SYSTEM VULNERABILITY AND SURVIVABILITY
UCRL-90129 December 1983
Submitted to Nuclear EMP Meeting
(NEM 1984) to be held at the
Baltimore Hilton, July 2-6, 1984

G. C. Corynen

Abstract

We discuss a framework for evaluating the vulnerability and survivability of systems which operate in stressful environments. Although applicable to a wide variety of complex systems, it is particularly powerful when applied to systems exposed to weapons effects such as EMP, where certain modeling assumptions are naturally satisfied.

Other methods for obtaining vulnerability and survivability exist, but they have various limitations. From a modeling point of view, current methods do not satisfactorily address dynamical issues such as event timing and delays, network problems such as routing of messages, and hierarchical issues associated with command and control structures. From a computational viewpoint, current methods are inefficient, and their complexity increases exponentially as the size of systems is increased linearly.

Our generalized network approach involves a new modeling and computation method. The modeling method consists of a two-tiered hierarchical approach involving a network tier at the top and subsystem tier below. The network tier represents flows of information, controls, and actions, and explicitly accounts for the timing of events and any delays. In this tier, performance is determined by the performances of nodes and links of the network.

The purpose of the subsystem level is to model each node and link of the network as a subsystem of interconnected components in order to allow a thorough description of flows into and out of nodes and of flow transformations within nodes.

Our computation approach is based on the methods of discrete mathematics, which allow a full exploitation of network and tree structure, thereby gaining considerable efficiency. In contrast to current methods, the complexity of our approach is polynomial.

To guide the user in the computer implementation of network models, we have developed the notion of a Cybernetic Module (C-Module), which provides a highly structured interface between the network and the subsystem level.

Our presentation will provide examples of how the framework is used, and will describe typical computations required to assess system vulnerability and survivability.

83-88 SCALE MODEL TESTING FOR EMPRESS II ANTENNA RESPONSE APPLICATIONS

L. C. Martin
H. G. Hudson

UCRL-90120 December 1983
Submitted to Nuclear EMP Meeting
(NEM 1984) to be held at the
Baltimore Hilton, July 2-6, 1984

Abstract

The EMPRESS II EMP simulator design concept includes a barge-mounted vertically polarized conical antenna. The concept is based on the VPD-II EMP simulator located at Kirtland AFB, New Mexico. The EMPRESS II antenna is conical in shape as approximated by a hexagon in the horizontal cross section. A scale model was constructed and testing was performed to support computer code development for prediction of the antenna response characteristics. The conical section was mounted on a scale model of the barge. Tests were performed on the LLNL electromagnetic transient test range facility which permitted computation of scale model impedance from the test data. These results compared favorably with those obtained from a separate compute code simulation.

83-89 INTERACTIVE COMPUTER-AIDED CONTROL SYSTEMS ENGINEERING

C. J. Herget
D. T. Gavel
D. M. Tilly

UCRL-89870 December 1983
Submitted 2nd Annual Workshop on Interactive Computing, IEEE Computer Society, Washington DC December 2, 1983

Abstract

In this article, we will briefly present an overview of activities in the relatively new field of Computer-Aided Control Systems Engineering. We will discuss the nature of control system design using computers, provide references to present activities, and discuss our current effort in this field.

83-90 ENERGY DIVISION: A GRAPHICS SPECIFICATION FOR GRAPHICAL REQUIREMENTS FOR COMPUTER-AIDED CONTROL SYSTEM DESIGN

S. A. Bly

UCID-19954 December 1983
Prepared for Oak Ridge National Laboratory

Introduction

The following report on graphics for computer-aided control system design (CACSD) is intended to specify the graphics requirements for CACSD and to suggest a method for meeting those requirements. This assumes that there is some basic set of graphical capabilities that is generally useful to the computer-aided control systems community. Given some agreement on that set of capabilities, the problem then is to determine the best way to meet those needs. Questions arise regarding the possible hardware environments, the effect of graphics standards, the ability to provide portable software, the flexibility for future enhancements, and the availability of existing graphics of software.

83-91 PICTURE: AN INTERACTIVE TOOL FOR CREATING VISUAL AIDS - REFERENCE MANUAL - VERSION 2.0

R. R. Springmeyer
S. A. Bly

UCID-19998, December 1983

Version 2.0 Picture

The Picture utility generates user defined pictures with black-and-white or color output, suitable for viewgraphs, slides, report diagrams, - in general, any application requiring visual aids. The interactive menu-driven system allows a user to create a picture consisting of text, straight lines, graphs, an assortment of markers, splines and drawings, all in a variety of colors. Commands for manipulating the picture include moving, scaling, rotating, deleting, copying and changing the color of objects. Text strings may be aligned left, right, or centered, and have a vertical or horizontal path. Markers, circles and the large bold font may be filled or unfilled. The user may add or delete one of two overlay grids for help in positioning items. The final product may be saved in a text file for later retrieval.

APPENDIX A

Author Index

APPENDIX A (Cont.)

Author Index

APPENDIX A (Cont.)

Author Index

APPENDIX B

Keyword Index

APPENDIX B (con't)

Keyword Index

APPENDIX B (con't)

Keyword Index